

Basic Stellar Parameters of Giant and Supergiant Stars as measured with PTI. II

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PTI

Palomar Testbed Interferometer



Palomar
Testbed
Interferometer

The Data

- Angular sizes from PTI, IOTA data
 - 83 stars from PTI (van Belle *et al.* 1998)
 - 82 stars from IOTA (Dyck *et al.* 1996, 1998)
 - Luminosity class I, II, and III stars
- Photometry from IRAS PSC (1986), Gezari (1996), other sources
 - V-K and K-[12] colors
- Log g , [Fe/H] from Cayrel de Strobel *et al.* (1997) catalog

Effective Temperature

Effective temperature is defined as

$$L = 4\pi R^2 T_{\text{EFF}}^4,$$

which can be rewritten as

$$T_{\text{EFF}} = 1.316 \times 10^7 \left(\frac{F_{\text{TOT}}}{q_{\text{R}}^2} \right)^{1/4}$$

where F_{TOT} is the bolometric flux (W cm^{-2}), q_{R} is the Rosseland mean stellar angular diameter (mas)

Linear Radius

- Linear radius is simply:

$$R = \frac{q}{2} \times d$$

- Hipparcos (1997) distances now available
- Uncertainties in parallax (typically ~15-20%) still largest contribution to error
- Range of sizes : 10-300 R_{SUN}

Mass

From the definition of surface gravity:

$$g = \frac{GM}{R^2}$$

we can use values for $\log g$ and R to estimate M .

Range of measured values: $0.64 M_{\text{SUN}} - 68 M_{\text{SUN}}$

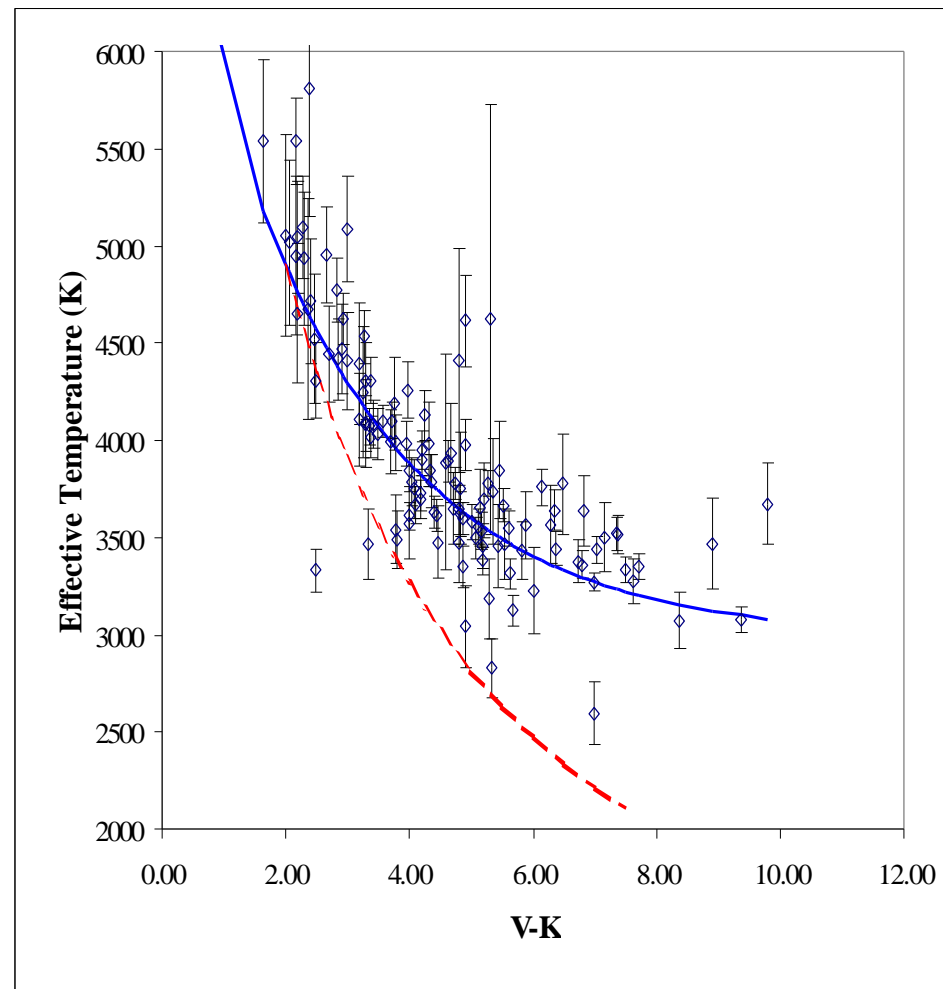
- Consistent with expected extremes

Caveats!:

- $\log g$ values are typically model-dependent
- Errors are +/- a factor of two

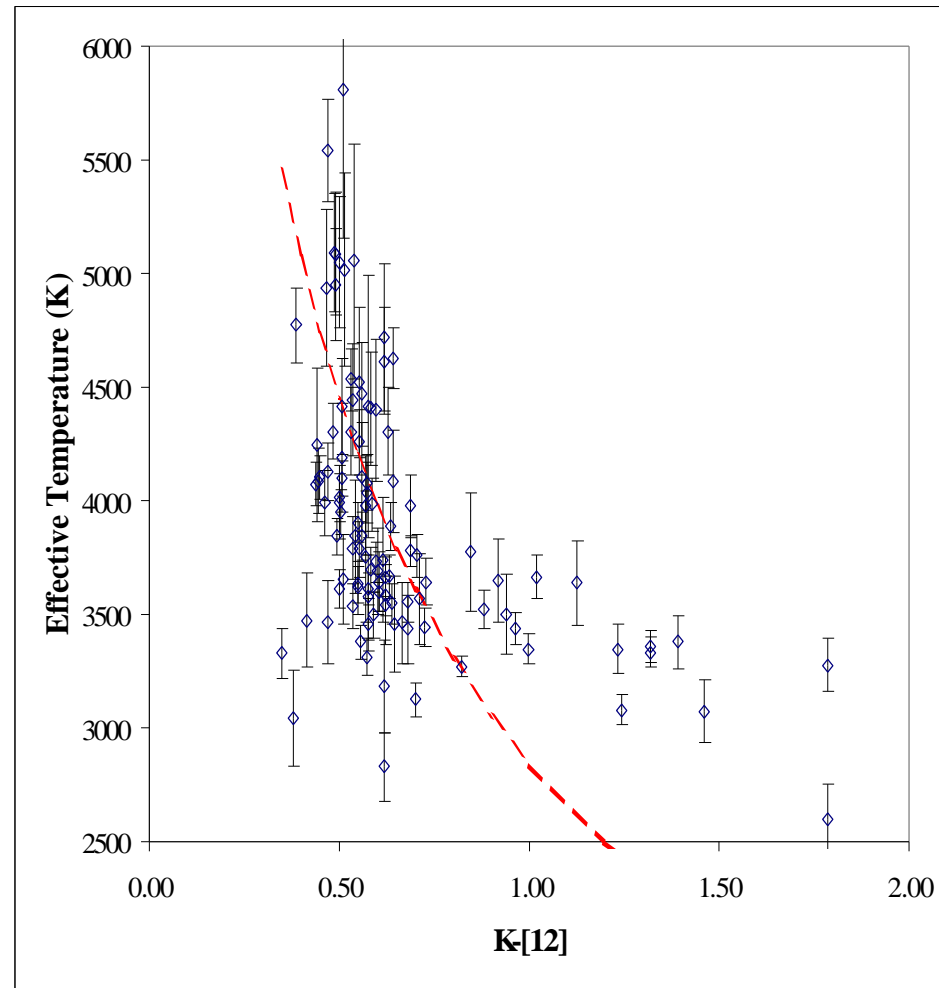
Effective Temperature vs. V-K Color

- Blue: fit
- Red: Blackbody behavior
- Indications of increased absorption bands at V at low T_{EFF} (Barbuy *et al.* 1992, Jørgensen 1994)



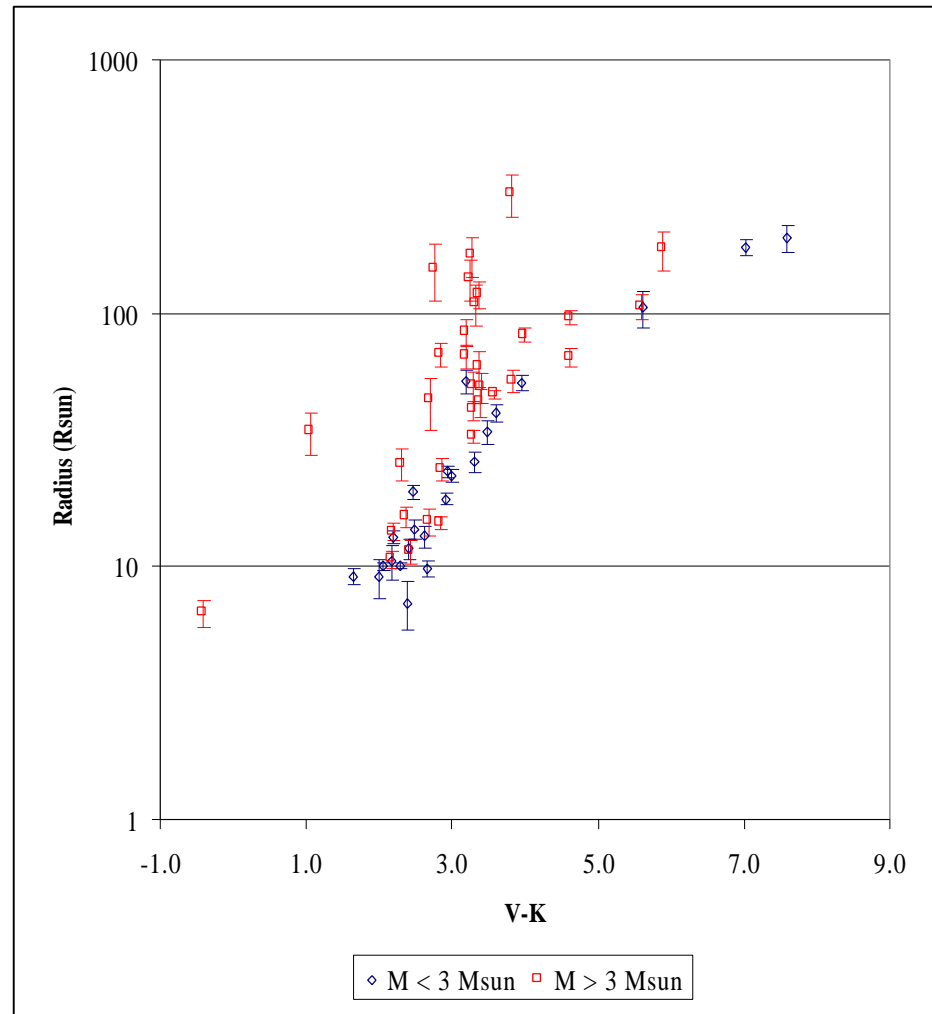
Effective Temperature vs. K-[12] Color

- K-[12] reasonable indicator of dusty mass loss
- Red: Blackbody behavior
- Substantial departure from BBR curve at K-[12] ~ 0.80
- Indication of onset of mass loss (Le Sidaner & Le Bertre 1996, Beichman *et al.* 1990)



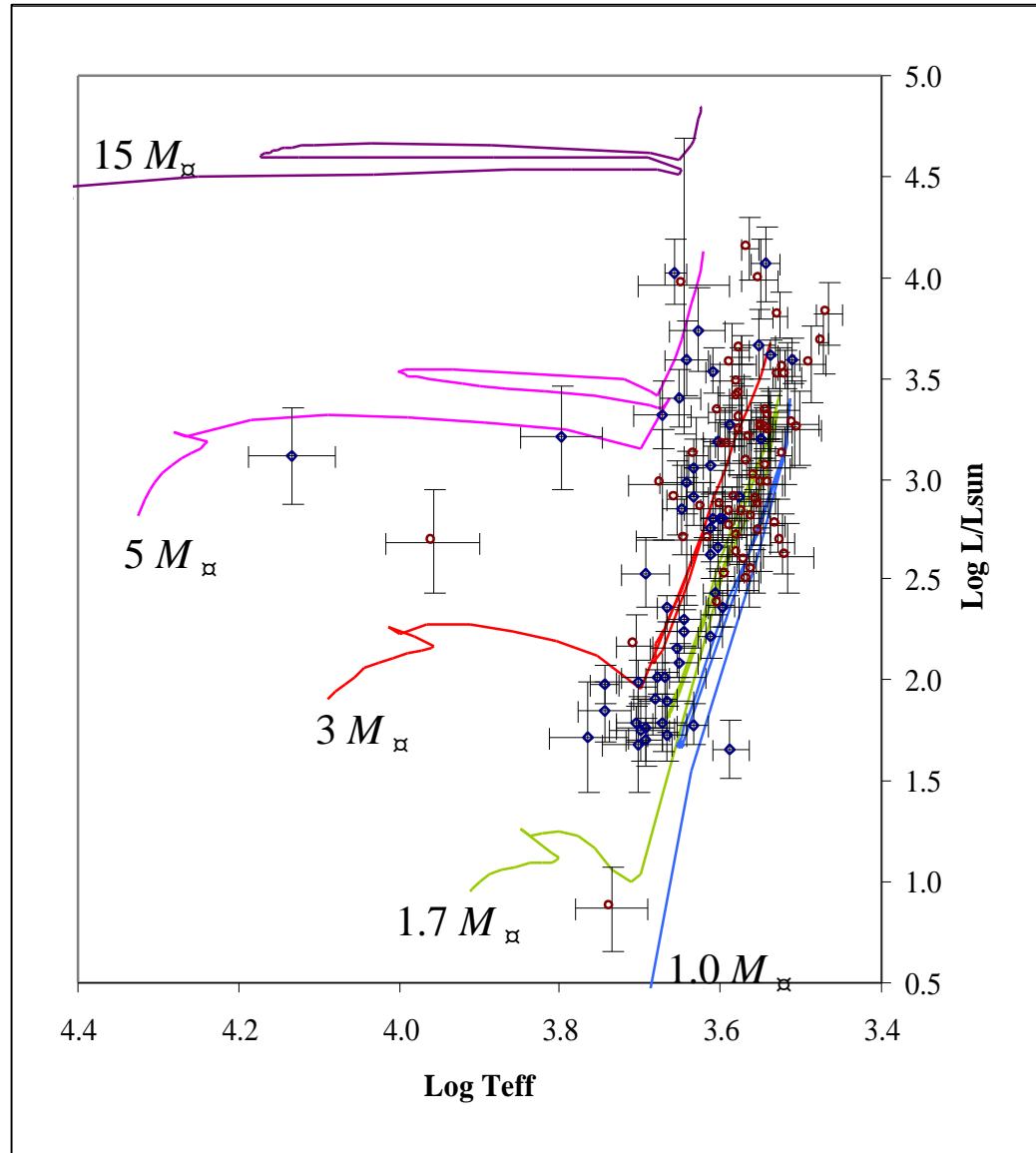
Radius vs. V-K Color, Mass

- Separation of low- to high-mass stars at $3 M_{\text{SUN}}$
 - Resolves some of the degeneracy of the radius/V-K relationship
- Low-mass stars fairly well behaved
- Well-defined lower edge curve
 - Change in power law at $V-K = 4$: $R \sim (V-K)^4 \rightarrow R \sim (V-K)^2$



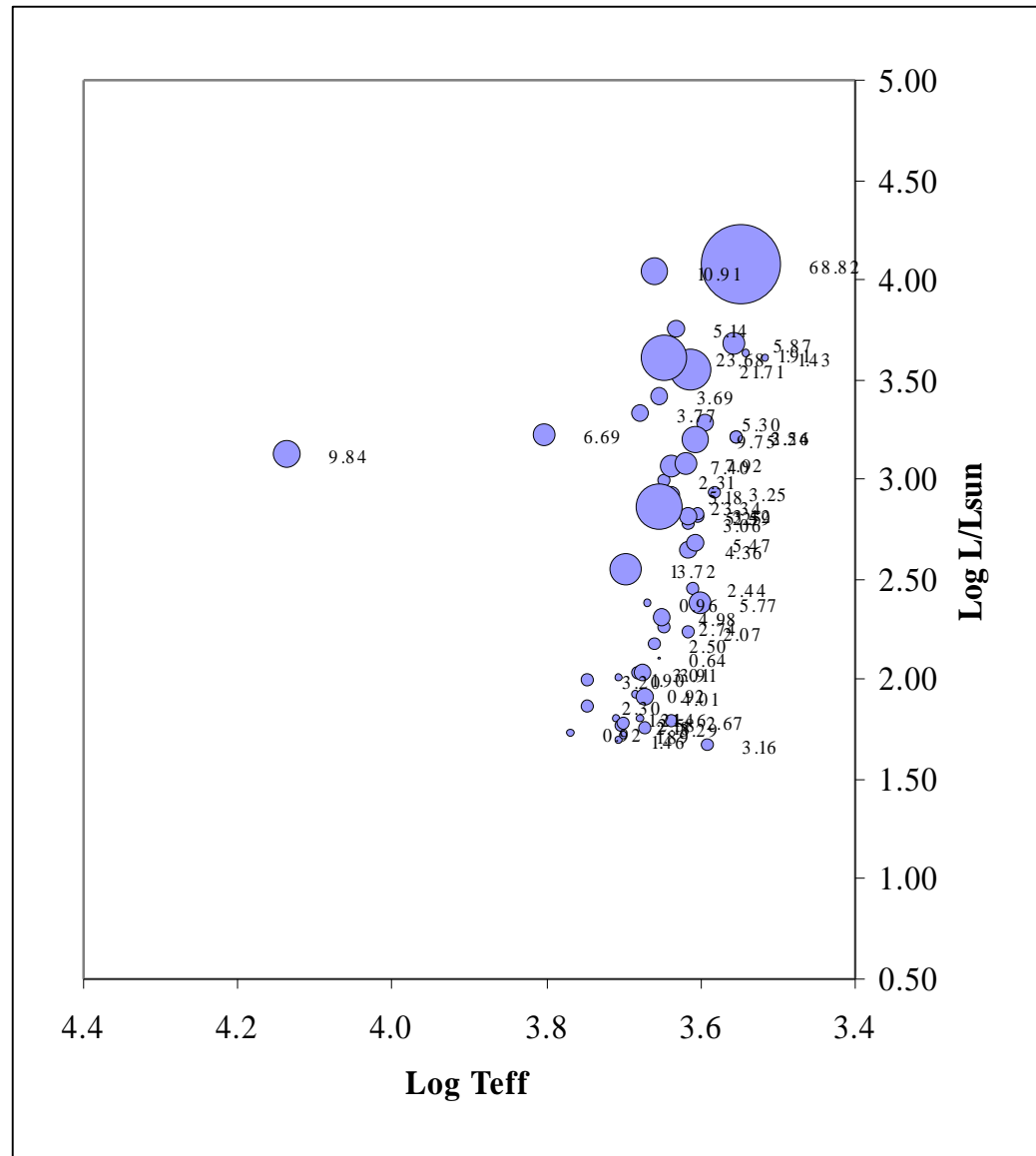
Luminosity vs. T_{EFF} with Model Tracks

- Model Tracks:
 - All tracks are $Z=0.02$ (solar)
 - Tracks from 1.0 - 15 solar masses
 (Schaller *et al.* 1992, Charbonnel *et al.* 1996)
- Good general agreement with the tracks
- Poor sampling of hotter stars
 - Selection effect



Luminosity vs. T_{EFF} by Mass

- Plot points scaled by mass
- Gradual gradient in mass from hot+dim to cool+bright
- Poor comparison to model tracks outside of 1.7-3 M_{SUN} range



- Plot points scaled by radius
- Gradual gradient in radius from hot+dim to cool+bright
- Good comparison in measured values versus expected lines of constant radius (Iben 1991)

